

MA MAJOR RESEARCH PAPER

**TWENTY YEARS OF UNNECESSARY FORWARD SLASHES:  
TOWARDS A POST-ONTOLOGICAL CRITIQUE OF TIM BERNERS-LEE'S  
EVOLVING ASPIRATIONS FOR THE WEB AND THE WORLD WIDE WEB  
CONSORTIUM FROM THE CULTURAL STUDIES PERSPECTIVE**

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To my Aunt, Ruth Berenson  
(1917 – 2010)

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**Abstract**

Since it was first formally proposed in 1990 (and since the first website was launched in 1991), the World Wide Web has evolved from a collection of linked hypertext documents residing on the Internet, to a “meta-medium” featuring platforms that older media have leveraged to reach their publics through alternative means. However, this pathway towards the modernization of the Web has not been entirely linear, nor will it proceed as such. Accordingly, this paper problematizes the notion of “progress” as it relates to the online realm by illuminating two distinct perspectives on the realized and proposed evolution of the Web, both of which can be grounded in the broader debate concerning technological determinism versus the social construction of technology: on the one hand, the centralized and ontology-driven shift from a human-centred “Web of Documents” to a machine-understandable “Web of Data” or “Semantic Web”, which is supported by the Web’s inventor, Tim Berners-Lee, and the organization he heads, the World Wide Web Consortium (W3C); on the other, the decentralized and folksonomy-driven mechanisms through which individuals and collectives exert control over the online environment (e.g. through the social networking applications that have come to characterize the contemporary period of “Web 2.0”). Methodologically, the above is accomplished through a sustained exploration of theory derived from communication and cultural studies, which discursively weaves these two viewpoints together with a technical history of recent W3C projects. As a case study, it is asserted that the forward slashes contained in a Uniform Resource Identifier (URI) were a social construct that was eventually rendered extraneous by the end-user community. By focusing on the context of the technology itself, it is anticipated that this paper will contribute to the broader debate concerning the future of the Web and its need to move beyond a determinant “modernization paradigm” or over-arching ontology, as well as advance the potential connections that can be cultivated with cognate disciplines.

## Introduction

Looking at the mechanism alone is like watching half the court during a tennis game; it appears as so many meaningless moves. What analysts of artifacts have to do is similar to what we all did when studying scientific texts: we added the other half of the court.

– Bruno Latour, 1992<sup>1</sup>

Working in the tradition of Latour and other theorists who espouse the social construction of technology, the aim of this paper is to examine competing viewpoints on the future of the World Wide Web by analyzing the theoretical paradigms underlying their trajectories. By “adding this other half of the court” so to speak, I will endeavour to problematize the commonly-accepted modernization paradigm of the technology (one that I argue subscribes to the modernist notion of “progress” within the context of Enlightenment thought and a rigid taxonomical structure) by illuminating areas that I assert do not receive enough consideration in both the academic and practitioner-oriented literature on the evolution, structure, and operation of the Web. Additionally, this paper will serve to outline and introduce a broader research agenda in the area of Web Studies, particularly in preparation for a larger historiographical piece that may be undertaken on this same subject in future. In the interest of brevity, I will frame the present discussion of recent work on the next-generations of the Web in the context of one very specific transformation within the history of the Web – namely the rendering extraneous by end-user communities of the cultural object reflected by the forward slashes one would normally include in the Uniform Resource Identifier (URI).

This vignette is inspired by the October 2009 admission of the Web’s inventor, Sir Tim Berners-Lee, that the decision to initially require a user to type “http://” before the rest of the

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1. Bruno Latour, “Where are the missing masses? The sociology of a few mundane artifacts,” in *Shaping technology/building society: Studies in sociotechnical change*, ed. Wiebe E. Bijker and John Law (Cambridge, MA: MIT Press, 1992), 247.

address was arbitrary, possibly simply an attempt to emulate common computing syntax of the time. The forward slashes, in particular, were a focal point of his admission: “Really, if you think about it, it doesn’t need the //. I could have designed it not to have the //...It seemed like a good idea at the time”.<sup>2</sup> Although this was, in effect, a minor news story, its place within Web Studies and within the history of the medium is arguably significant.

This importance can be inferred both through the admission that something affecting so many eventual users of the technology came down to one small, arbitrary, decision effectively made by one person, and also because the story fails to acknowledge on the over-arching issues raised by the fact that entering the slashes is no longer a requirement. (It only acknowledges the fact that most browsers automatically assume this “prefix.”) Indeed, it is my position that the introduction of this “shortcut” reflects the broader challenges to a unified treatment of the advancement of the technology. More specifically, this anecdote of the “unnecessary forward slashes” can usefully be examined within the framework of two major theoretical perspectives on the Web, which I will explore by providing context and a discussion of some of the core technical literature in the remainder of this paper.

### **The Slashes in Context: Tim Berners-Lee’s Evolving Vision for the Web and the W3C**

Providing a complete cultural history of the Web is beyond the scope of this paper. This said, the origins of the forward slashes as part of the medium’s configuration can be traced to the very invention of the technology, which demands further elaboration. Tim Berners-Lee’s earliest proposals for a system that resembles the basic structure of today’s World Wide Web date back to 1989. At this time, while working as a research scientist at CERN, he formally proposed to his

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2. Murad Ahmed, “Backslash: Web creator Sir Tim Berners-Lee apologises for his strokes,” *The Times*, October 14, 2009. <http://technology.timesonline.co.uk> (accessed March 30, 2010).

superiors a distributed data management system based on a prior development (his “ENQUIRE” software project written in 1980). Shortly thereafter, in 1990, he revised the proposal to include the concept of “hypertext”, wherein what we would now refer to as web pages or web sites could be written in HyperText Markup Language (HTML), connected to each other via “hyperlinks”, accessed via the HyperText Transfer Protocol (HTTP) and via a Uniform Resource Identifier (URI) – with “//” intact – and displayed in a browser on the client’s machine.

By 1991, the Web emerged as a non-proprietary, publicly-available service on the Internet, and the subsequent advent of what became the first “popular” graphical Web browser in 1993 (i.e. Marc Andreessen’s “Mosaic”) popularized the medium. This chain of events is recounted in the inventor’s autobiographical book, *Weaving the Web*.<sup>3</sup> The book also outlines what Berners-Lee terms the “ultimate destiny” of the Web, and it is this point that effectively foreshadows the major challenge to the linear paradigm of progression and modernization that has been presented thus far. This is especially so in light of the influence Berners-Lee still holds in the development of the technology, due to his position as head of the World Wide Web Consortium (or W3C, the organization he founded in 1993 with the support of MIT and the Defense Advanced Research Projects Agency or DARPA upon leaving CERN).<sup>4</sup> Although it would be incorrect to state that all of Berners-Lee’s recent work has been related to his position at the W3C, this connection is relevant for the purposes of this paper.

### *The Semantic Web*

As a specific manifestation of this influence, Berners-Lee has consistently advocated a restructuring of the Web, wherein both existing and new data stores are coded in such a way as

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3. Tim Berners-Lee and Mark Fischetti, *Weaving the Web: The original design and ultimate destiny of the World Wide Web* (San Francisco: Harper Business, 1999).

4. World Wide Web Consortium, “Project website,” <http://www.w3.org> (accessed April 25, 2010).



to allow machines to infer meaning, rather than having markup languages code only for the way in which information is to be displayed on screen. For example, a search for the word “Jaguar” will often return hits related to the car, the animal, and the operating system, since the word appears on various sites as a result of HTML markup that explains to the browser only where (i.e. within the document) and how (i.e. bold, italic, red, black, etc.) the word is to be displayed. Berners-Lee proposes that instead, by marking up objects with the Extensible Markup Language (XML) or other XML-based languages, one can effectively code for *semantics* (i.e. by using a “triple structure” in which one can specify the intended structure and meaning, such as “Jaguar is a type of car”), as well as for display criteria.

It is this focus on *both* syntax and semantics that forms the core of Berners-Lee’s Semantic Web concept. This has the ultimate aim of transforming the present, human-understandable “Web of Documents” to a robust “Web of Data” that can be leveraged by machines and “intelligent agents” to automate various Web-related search tasks.<sup>5</sup> Although this concept is outlined in *Weaving the Web*, its technical details are more fully fleshed-out in a 2001 *Scientific American* article authored by Tim Berners-Lee, James Hendler, and Ora Lassila.<sup>6</sup> (The material below also addresses the underlying technology and socio-technical implications, while

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5. In order to ensure relevancy to non-programmers, this paper describes the Semantic Web in largely superficial terms. For a more thorough technical background (encompassing the shift to XML and RDF-based markup languages, coupled with ontology models written in the Ontology Web Language or OWL), consult Paul Warren and John Davies, “The Semantic Web - from vision to reality,” in *ICT futures: Delivering pervasive, real-time and secure services*, eds. Paul Warren, John Davies, and David Brown (West Sussex, England: John Wiley & Sons, 2008): 55-66. For a substantive update on the technological development of the Semantic Web since its introduction (including details on the development of W3C standards regarding semantic markup languages like RDF and OWL, as well as further information on ontologies, RDF Schema, and linkages of these with the provision of web services), see Eric Miller, “The W3C’s Semantic Web activity: An update,” *IEEE Intelligent Systems* 19, no. 3 (2004): 95-97. Finally, for a discussion on how semantic technologies can be implemented into the fabric of mainstream Web services (albeit with limited success to date), see Lee Feigenbaum, Ivan Herman, Tonya Hongsermeier, Eric Neumann, and Susie Stephens, “The Semantic Web in action,” *Scientific American* 297, no. 6 (December 2007): 90-97.

6. Tim Berners-Lee, James Hendler, and Ora Lassila, “The Semantic Web,” *Scientific American* 284, no. 5 (May 2001): 34-43.

footnotes direct readers to other relevant documents, many of which are primary texts authored by the W3C itself, or by scholars who are directly affiliated with it.)

Realizing the vision of the Semantic Web can proceed in two ways, both of which are discussed by computer scientists Mark Greaves and Tom Heath and relate to the concept of the “ontology”, or the lack thereof<sup>7</sup>: on the one hand, existing and newly-created data can be annotated using a prescribed vocabulary that is common to a specific industry (e.g. all parts suppliers in the automotive industry agree on a knowledge representation scheme where a catalytic converter is identified as being a part of the exhaust system<sup>8</sup>); on the other, individuals can annotate data as they see fit and, in doing so, create “folksonomies” (a portmanteau of “folk taxonomies”).<sup>9</sup> The latter case has already entered the mainstream through numerous “Web 2.0” applications that rely on collective knowledge management, namely the social production that is at the root of a Wiki, a social networking site, or an aggregator of user-generated video content (e.g. “YouTube” and other sites with a similar focus).

Even with tools that allow a certain degree of automation, creating highly-defined technical ontologies is indeed a daunting task, most notably because data remains “trapped” in the various Web services databases of organizations, and this material must be “mined” in order

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7. In the literature reviewed in this paper, the term “ontology” is used in the technical sense, as a core concept germane to the Semantic Web. However, I acknowledge that some researchers may find this term to be problematic, given its specific meaning within philosophy (and the fact that much of my discussion on the Web here is epistemological rather than ontological). An interesting area for further research that would be worth pursuing relates to the W3C’s choice of this term within the Semantic Web framework, particularly why such a term was appropriated rather than using something more descriptive and less controversial (e.g. “semantic structure”).

8. This particular example is drawn from a separate text I co-authored on the Semantic Web and its relation to collaborative communication and industrial design. See Michael J. Murphy, Michael Dick, and Thomas Fischer, “Towards the ‘Semantic Grid’: A state of the art survey of Semantic Web services and their applicability to collaborative design, engineering, and procurement,” *Communications of the IIMA* 8, no. 3 (2008): 11-24.

9. Mark Greaves, “Semantic Web 2.0,” *IEEE Intelligent Systems* 22, no. 2 (2007): 94-96; Tom Heath, “How will we interact with the web of data?” *IEEE Internet Computing* 12, no. 5 (2008): 88-91.

to produce the ontologies required to proceed.<sup>10</sup> Strategies for accomplishing this are centred on “scrubbing” XML databases (within this so-called Deep Web) so that popular search engines can properly annotate the found data with semantic markup languages.<sup>11</sup> In the literature, this effort is predicted to go beyond the proprietary algorithms utilized by the leading search engines and information retrieval organizations, and can be considered more worthy of the “Web 3.0” moniker than the Semantic Web alone. This is because accomplishing it requires both research tracks on leading-edge Web technologies be combined in the pursuit of a new generation of World Wide Web that embraces ubiquitous machine-understandable content.<sup>12</sup>

Facilitating this transition from a Web that displays documents to a Web that interprets data has been a priority for Berners-Lee and the W3C over the past decade, as demonstrated by the rigorous standards they have set for the approval of new markup languages, and an active research dissemination agenda in computing and engineering journal publications and conference proceedings. Further to this initiative, Berners-Lee and the W3C have launched three other major projects that also outline their vision of the Web’s future. One, the Web Science Trust, is intended to promote the Web Science Research Initiative (WSRI) undertaken in 2005 to direct the technical and socio-technical research agenda related to the Web (i.e. to develop a methodological framework that accommodates positivist studies of the underlying network topologies of the Web). The second, the Mobile Web Initiative (MWI), was undertaken by the W3C in 2005 to develop coding and application standards to extend the Web’s capabilities to

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10. James Geller, Soon Ae Chun, and Yoo Jung, “Toward the Semantic Deep Web,” *Computer* 41, no. 9 (September 2008): 95-97.

11. Alex Wright, “Searching the Deep Web,” *Communications of the ACM* 51, no. 10 (2008): 14-15.

12. Additional analysis on this point can be found in James Hendler, “Web 3.0: Chicken farms on the Semantic Web,” *Computer* 41, no. 1 (January 2008): 106-108; and James Hendler, “Web 3.0 emerging,” *Computer* 42, no. 1 (January 2009): 111-113. It is important to note that practitioner-oriented literature related to this discipline lacks a controlled vocabulary; therefore, terms like “Web 2.0” and “Web 3.0” in particular should be taken within the context in which they are used within each respective text.

mobile devices. Finally, the Mobile Web for Social Development Working Group (MW4D) and the related World Wide Web Foundation, were created in 2006 and 2008 respectively in order to apply the Consortium's work to narrowing the so-called "digital divide" that is perceived to exist between the Global North and the Global South. To provide additional context that furthers my point about a preeminent "modernization paradigm" evoking an approach where the ontology in a technical sense dominates the discourse concerning Web development, I will now briefly discuss each of these in turn.

### *The Web Science Trust*

Although annual conferences on the subject have been held since March 2009 – in addition to the existence of a dedicated journal for the discipline and the recent emergence of related research institutes and academic programs – the seminal document of Web Science remains, at this time, a set of proceedings that emerged from meetings held by what was then the WSRI (now taken up within the scope of the Web Science Trust, among other things) in 2005 and 2006. Entitled "A Framework for Web Science", the text consists largely of a discussion of engineering issues that are central to the Web's decentralized nature.<sup>13</sup> The technical specifics of these issues generally relate to the Semantic Web concept, as previously discussed. Although subsequent chapters do focus on issues of governance and managing the socio-economic impact of the Web, these do not progress beyond broad generalizations concerning security, privacy, and trustworthiness of the data itself at code level.

For example, the authors outline some eventual goals for the discipline with respect to policy (i.e. the perceived need to avoid regulation by the State in order to maintain a sense of democracy online), use of the technology in a way that optimizes social benefit, and outreach

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13. Tim Berners-Lee, Wendy Hall, James A. Hendler, Kieron O'Hara, Nigel Shadbolt, and Daniel J. Weitzner, "A framework for Web Science," *Foundations and Trends in Web Science* 1, no. 1 (2006): 1-130.

activities. This said, an actual action plan for achieving these goals (or at least an agenda for further research) is not included, although a general roadmap does exist on their project website.<sup>14</sup> In other words, while there is an assertion that forming this new discipline is required in order to advance our understanding of the Web, this concept document does not actually address anything on a macroscopic level. The fact that a trust has been established to promote the proposed discipline may, however, be expected to enlarge and enhance the Web Science approach in the coming years.<sup>15</sup> Among its other activities, the Trust seeks to stimulate further inquiry pertaining to the areas identified within the WSRI's concept document and other work. It also helps foster broader acceptance of the discipline in academic circles, and has so far helped influence the creation of both research institutes and entire academic degree or collaborative programs dedicated to the field of Web Science.<sup>16</sup>

This said, ambiguity surrounding this discipline remains, and this is further aggravated by some of the initial responses to Web Science, particularly in academic literature where I would argue rigor is indeed lacking. As an example, we can consider the Web Science Trust's professed approach to "awaken Computer Science to the interdisciplinary possibilities of the Web's socially embedded computing technology" by conducting existing Web-related research under

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14. Nigel Shadbolt, "Research Roadmap – Web Science Trust," November 2008. <http://webscience.org/research/roadmap.html> (accessed July 14, 2010).

15. News of the launch of the Web Science Trust (and its relation to the former WSRI and similar initiatives) can be found in Mark Fischetti, "A science of the Web begins," *Scientific American*, November 2, 2006. <http://www.sciam.com/article.cfm?id=a-science-of-the-web-begi> (accessed April 25, 2010).

16. Information on the launch of the Web Science Trust Network of Laboratories (WSTNet) can be found in "New Web research network gets off the ground," *Science|Business*, April 29, 2010. <http://bulletin.sciencebusiness.net> (accessed May 1, 2010). A discussion on an exemplary University-based research unit dedicated to Web Science, the Institute of Web Science at the University of Southampton and Oxford University, as well as information on a degree program in the field can be found in Rebecca Thomson, "Web science: Exploring the network without guesswork," *New Scientist*, May 10, 2010. <http://www.newscientist.com> (accessed May 12, 2010).

the guise of Web Science.<sup>17</sup> Gestures to other fields outside the purview of computer science are similar in that they seem convincing, but are actually support by limited empirical evidence. For example, consider the perfunctory suggestion to study Web Science's implications on technology enhanced learning, a topic that is presently in vogue within the computing literature.<sup>18</sup> Moreover, investing significantly in Web Science research to find applied solutions to problems like identity theft is presented as a means to "protect our future".<sup>19</sup> Again, Web Science literature is very general in its applications to society and is, as of yet, peppered with hyperbole. However, it must be remembered that scholarship in this field (or rather under this specific rubric) is relatively new, and requires greater fermentation to produce tangible results.

### *The Mobile Web Initiative*

Turning now to the Mobile Web, the emergence of this concept can be linked to the W3C's Mobile Web Initiative (MWI).<sup>20</sup> This was launched in 2005 in part to provide guidance and support to application developers interested in creating software and services for this

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17. Ben Shneiderman, "Web Science: A provocative invitation to Computer Science," *Communications of the ACM* 50, no. 6 (2007): 25. This mandate for the discipline is repeatedly and consistently "professed" across computing literature. For other examples of this, see Tim Berners-Lee, Wendy Hall, James Hendler, Nigel Shadbolt, and Daniel J. Weitzner, "Creating a science of the Web," *Science*, no. 5788 (August 2006): 769-771; and James Hendler, Nigel Shadbolt, Wendy Hall, Tim Berners-Lee, and Daniel Weitzner, "Web Science: An interdisciplinary approach to understanding the Web," *Communications of the ACM* 51, no. 7 (2008): 60-69.

18. Kieron O'Hara and Wendy Hall, "Web Science," *Association of Learning Technologies Newsletter*, no. 12 (May 2008).

19. Nigel Shadbolt and Tim Berners-Lee, "Web Sciences Emerges", or "Web Science: Studying the Internet to protect our future," *Scientific American* 299, no. 4 (October 2008): 32 or 76. Note that this article was published in two different versions within the cited periodical, hence the alternative title and pagination.

20. Mobile Web Initiative (MWI), "About the Mobile Web initiative," World Wide Web Consortium. <http://www.w3.org/Mobile/About> (accessed October 23, 2009). As noted, this paper focuses on the concept of the "Mobile Web" within the context of the W3C's "Mobile Web Initiative". For further background on the former, see Michael Fitzgerald, "Mobile Web: So close yet so far," *New York Times*, November 27, 2007; Eric Knorr, "Mobile Web vs. reality," *Technology Review* 104, no. 5 (2001): 56-61; Ellyssa Kroski, "What is the Mobile Web?" *Library Technology Reports* 44, no. 5 (2008): 5-9; and Jessie Scanlon, "Moving to the Mobile Web," *BusinessWeek Online*, no. 14 (2008). EBSCO (accessed October 23, 2009).

medium.<sup>21</sup> Indeed, at the outset, the MWI enveloped prior application standards such as WAP, along with a variety of open-source and proprietary mobile browsers, in order to develop a set of best practices for mobile platforms.<sup>22</sup> Such directives focus broadly on exploiting device capabilities, navigation, page layout, and content.<sup>23</sup> In view of the immense market potential for mobile devices, the corporate sector in particular has a vested interest in ensuring the development of standards for both the network backbone of the Mobile Web and the devices and browsers themselves.

### *The Mobile Web and International Development*

There is also an attempt to combine the MWI with the field of Information and Communication Technology for Development (ICT4D), to take advantage of the existing partnerships between academia, the public sector, and various industries, to advance the interests of developing countries and underprivileged populations. This goal is at the core of a sub-group of the MWI, namely the “Mobile Web for Social Development Interest Group” (MW4D).<sup>24</sup> This initiative was formally launched by the W3C’s MWI in 2008 as part of the European Union’s “Seventh Research Framework Programme” (FP7) and the “Digital World Forum” project (which is focused on ICT4D in Africa and Latin America).<sup>25</sup> However, this announcement

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21. Justin Richards, “Mobile Web,” *ITNow* 48, no. 5 (September 2006): 10.

22. WAP (the Wireless Application Protocol) was first deployed in 1997, and is widely considered antiquated today on account of its tedious navigational structure and limited display capabilities. For further information on the technology, see Jennifer Dejong, “Mobile Web,” *PC Magazine* 20, no. 13 (July 2001): 140-143; and for further discussion on its limitations to the ICT4D movement see Chris O’Malley, “Wireless Web or prison cell? (Combining the World Wide Web and mobile phones),” *Popular Science* 256, no. 6 (June 2000): 11.

23. Steven J. Vaughan-Nichols, “The Mobile Web comes of age,” *Computer* 41, no. 11 (2008): 15-17.

24. Mobile Web for Social Development Working Group (MW4D), “Documents & resources,” World Wide Web Consortium. <http://www.w3.org/2008/MW4D> (accessed October 23, 2009).

merely served to generate interest in the project from potential external partners, as significant work in planning the mandate of the MW4D group began very shortly after the creation of the MWI in 2005, in part to offer an alternative research agenda towards narrowing the digital divide, one which differentiates itself on account of its focus on mobile telephony and related devices rather than more “traditional” computing hardware and software.<sup>26</sup> It is important to note that the W3C has expressed no interest to date in creating an alternative to the Web for those in developing countries to access on mobile devices; rather, they are intent on ensuring that the same World Wide Web can be accessed anywhere in the world on any mobile (or non-mobile) device. In effect, there is no alternative, mobile pathway to the Web from this perspective.

According to the MW4D group’s website, three major workshops on the Mobile Web in developing countries have been held to date. The first, which took place in December 2006 in Bangalore, India, outlined the necessity for the MW4D project and, in fact, led to the creation of the interest group. The second, held in June 2008 in Sao Paulo, Brazil, comprised a number of workshops on community-building, defining a roadmap for the group, and collecting information on resources of interest to the participants. The third, held in April 2009 in Maputo, Mozambique, focused specifically on the African perspective in Mobile Web-related ICT4D projects.<sup>27</sup> The white papers produced from these sessions capture the crux of the discussions, especially in terms of the challenges in using the Mobile Web for social development.<sup>28</sup>

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25. Business Wire, “W3C seeks partners to explore role of mobile in bridging digital divide; multidisciplinary forum to address access, literacy, sustainability challenges,” May 27, 2008. LexisNexis (accessed October 23, 2009).

26. Stéphane Boyera, “Can the Mobile Web bridge the digital divide?” *Interactions* 14, no. 3 (2007): 12-14.

27. Mobile Web for Social Development Working Group (MW4D), “Documents & resources,” World Wide Web Consortium. <http://www.w3.org/2008/MW4D> (accessed October 23, 2009).

28. For an example of one such report, see Stéphane Boyera, “White paper on Mobile Web for social development,” *World Wide Web Consortium*, 2008, [http://www.w3.org/2006/12/digital\\_divide\\_a jc](http://www.w3.org/2006/12/digital_divide_a jc) (accessed



This last point speaks to the key aim of the MW4D movement – “empowering underserved communities” through mobile technologies. However, the related “Key Focus Areas” document (available via the project’s website), clearly delineates this as a working group destined to make policy recommendations to, and based on conversations with, various levels of government, NGOs, and the private sector. This is in contrast to making direct connections with individual actors in civil society itself. Although this may make some sense from a logistical/diplomatic perspective, it does tend to undermine the initiatives to utilize mobile technology for educational means and to ensure its accessibility, both of which arguably inform the spirit of all of the W3C’s initiatives and both of which require direct involvement and feedback from their respective end-user communities.<sup>29</sup>

Furthermore, it can be argued that the telecommunications industry, in particular, has contributed to the widening of the digital divide because of its unequal deployment of new technologies between developed and developing countries, and that this must be taken into account when considering where solutions to concerns are emerging and for what purpose.<sup>30</sup> A broader discussion of the connections between the Web and ICT4D scholarship is worthwhile, but best left for another paper due to its added complexities. In summary, although the goal of broadening Web access through these projects is admirable, the Mobile Web (or, as I will illustrate, even the Web itself as it is envisioned by the W3C) should not be viewed as a panacea.

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October 28, 2009). Chief among the challenges raised are: the cost of data access; the availability of high-capacity networks and high-end handsets; the availability of content that is usable to local populations on both technical and non-technical levels; and the ways in which the technologies can be deployed so as to ensure they become meaningful in the daily lives of citizens within the local communities served.

29. Simon Harper, “Mobile Web: Reinventing the wheel?” *SIGACCESS Newsletter*, no. 90 (January 2008): 16-18; Simon Harper, Yeliz Yesilada, and Carole Goble, “Building the Mobile Web: Rediscovering accessibility?” *Universal Access in the Information Society* 6, no. 3 (2007): 219-220; and Keng Siau and Fiona Fui-Hoon Nah, “Mobile technology in education.” *IEEE Transactions on Education* 49, no. 2 (2006): 181-182.

30. Kilnam Chon, “The future of the Internet digital divide,” *Communications of the ACM* 44, no. 3 (2001): 116-117.

### *The World Wide Web Foundation*

A final W3C project to consider is the World Wide Web Foundation (hereinafter the “Web Foundation”), which was formally launched on November 15, 2009 to much fanfare at the fourth Internet Governance Forum in Sharm El Sheikh, Egypt.<sup>31</sup> As the latest of Berners-Lee’s initiatives (he serves as co-director of the foundation), I would argue it already reflects more than what is presented on the project’s website. For example, a key point of interest is the fact that 2007 is listed as the “watershed year” wherein the W3C began the conversation as to how the Web could be used for “positive social and economic change” and accessed by the “80% of the world not using it”.<sup>32</sup> At the same time, the core program areas for the project are encapsulated within three headings in the Executive Summary: the “Web in Society”, which includes mention of the Mobile Web concept; “Web Science”, which refers directly to the eponymous trust, alongside a proposed “Web Index” to more accurately measure the growth and usage of the medium; and finally, “Web Standards”, which refers directly to the W3C and the aforementioned roles it undertakes.<sup>33</sup> Furthermore, based on their references to the Web’s evolving complexities and emerging technical specifications respectively, I would infer that the latter two areas of focus are intended to encompass the Semantic Web and other coding-related projects.

Given the cultural history perspective I began this section with, I would indeed argue that the “three integrated programs” discussed above must be conceptualized with respect to all of Berners-Lee’s prior Web-related work, and not just the 2007 W3C discussions that the Web

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31. Janna Q. Anderson, “Tim Berners-Lee launches ‘WWW Foundation’ at IGF 2009,” *Ars Technica*, November 16, 2009. <http://arstechnica.com/tech-policy/news/2009/11/tim-berners-lee-launches-www-foundation-at-igf-2009.ars> (accessed December 14, 2009).

32. World Wide Web Foundation, “Our History,” <http://www.webfoundation.org/about/history/> (accessed December 14, 2009): para. 1.

33. Ibid., “Executive Summary,” <http://www.webfoundation.org/wpcontent/uploads/2009/11/WebFoundation-ExecSumm.pdf> (accessed December 14, 2009).

Foundation cites as a catalyst for the creation of this development-oriented initiative. In other words, this organization reflects, in many respects, an attempt on the part of Berners-Lee to: a) re-package the various elements of his research agenda in a manner beyond what the Web Science discipline was designed to achieve; and b) to then utilize such a package in the pursuit of international development efforts, again in a more coherent way than any of the constituent projects (e.g. MW4D) might achieve independently. I concede that this is a somewhat cynical view, and that it will require further research to solidify my core argument here; this said, I would posit that my preliminary reaction to this new foundation is immediately useful in two ways: first, it suggests that the Web Foundation is not grounded in development scholarship, rather it is an attempt to apply a particular, Western vision of technology's role in the pursuit of development; and secondly, in light of this, the argument could be made that Berners-Lee is continuing to exert significant control over a medium that he had originally placed in the public domain, and that the political economic implications of this can be seen as problematic.<sup>34</sup>

I feel this last point deserves some additional commentary with respect to the particular circumstances surrounding the Web Foundation. Although the organization is funded by a number of private benefactors, its launch raises questions about possible partnerships with government agencies (though not necessarily financial ones). For example, the IGF, which hosted the Web Foundation launch, grew out of meetings of the International Telecommunication Union's (ITU's) World Summit on the Information Society (WSIS), and desires to manage the over-arching policy framework on all Internet governance issues that currently fall outside the jurisdiction of the Internet Corporation for Assigned Names and

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34. This is to say, the Web has become the most popular medium on the Internet *because* of its decentralized nature, and that any attempts to control it must be carefully balanced with this perspective. This point will be taken up later in the paper, with respect to the work of Yochai Benkler.

Numbers (ICANN), and the World Intellectual Property Organization (WIPO).<sup>35</sup> One possible reason for including the Web Foundation in this event may thus correlate with a desire to leverage the structure and focus of the group to assume some responsibility for setting the policy agenda with regards to the management and control of the Web. Indeed, all of the aforementioned W3C research and development activities deserve a similar degree of scrutiny, with regard to their involvement in policy-making.

### **Technological Determinism: Conceptualizing the “Modernization Paradigm”**

Overall, an important point to note at the outset of an analysis on the recent activities of Berners-Lee and the W3C is the often deterministic nature of their projects. This is due to both the amount of control exercised over the “evolution” of an inherently-decentralized system like the Web, as well as the reliance on rigid knowledge-representation structures (i.e. ontologies) that are required to provide controlled terminology through which inferences are made in the Semantic Web model. The definition of “determinism” that I am using here is derived from Ben Anderson and Paul Stoneman, who re-frame the Marxian perspective of humans as being “enslaved” to machines through the more agnostic reaction they name the “snooker ball method”.<sup>36</sup> Essentially, as the analogy goes, thinking in this framework must suggest that the Web itself has a direct, causal impact on society (as one snooker ball hitting the other entails an action and a direct reaction). Put another way, this model or analogy reflects Newtonian mechanics extrapolated into the digital, online realm.

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35. According to Janna Q. Anderson. Note that, among other notable activities, ICANN manages the Domain Name System and the various Top-Level Domains, while WIPO is an agency of the UN that promotes intellectual property protection amongst its member states.

36. Ben Anderson and Paul Stoneman, “Predicting the socio-technical future (and other myths),” in *ICT futures: Delivering pervasive, real-time and secure services*, eds. Paul Warren, John Davies, and David Brown (West Sussex, England: John Wiley & Sons, 2008): 6-7. For an example of the “Marxian perspective” see Donald MacKenzie, *Knowing machines: Essays on technical change* (Cambridge, MA: MIT Press, 1996).

In this vein, among the most significant of conclusions that may be derived from this view of determinism is the possibility that the Web is somehow “alive”, since it is able to create effects on society, even in some very small. Philip Tetlow provides support for this idea, suggesting that the Web is evolving into an organism, supported by the added, artificial intelligence promised by the shift to the Semantic Web.<sup>37</sup> Although Tetlow’s framework could be seen as too speculative for Tim Berners-Lee and the Web Studies community, this should not detract from its value in helping to conceptualize one particular viewpoint on the “ultimate transformation” of the Web. Indeed, a separate discipline devoted entirely to studying networks in a similar vein – termed “Network Science” – has emerged in tandem with the work of Berners-Lee and the W3C. Its key proponent, Albert-László Barabási (2003) serves on the Scientific Council of the Web Science Trust, and argues that, with developments like the Semantic Web, we are moving towards a “Web without a spider” – that is a Web that once set in motion takes on a life of its own.<sup>38</sup> I would argue that Web Science may in fact be recognized as a sub-domain of “Network Science”, drawing upon similar lines of inquiry that are grounded in the broader tradition of “Systems Theory”. However, it is worth repeating that the speculative nature of these theories makes this claim difficult to envision with certainty.

For the purposes of this paper, “determinism” means a core group of people drive the technological evolution of the Web.<sup>39</sup> Such is the case with the foregoing initiatives, which is

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37. Philip Tetlow, *The Web's awake: An introduction to the field of Web Science and the concept of Web life* (Hoboken, N.J.: John Wiley, 2007).

38. Albert-László Barabási, *Linked: How everything is connected to everything else and what it means for business, science, and everyday life* (New York: Plume, 2003). For a full list of the Web Science Trust’s organizational structure, see “Creating a science of the Web (project website),” <http://www.webscience.org> (accessed April 25, 2010) and, more specifically, <http://www.webscience.org/people.html> (accessed July 14, 2010).

39. It is important to note that the terms “determinism” and “constructivism” are being used in a slightly unorthodox way within this paper. More specifically, I have chosen not to completely separate the role of human agency from the operation of computing machinery. Accordingly, “technological determinism” incorporates both

why I argue they constitute the dominant “modernization paradigm”. Further to this, determinism also means there are direct implications upon society, either predicted or occurring. Accordingly, although the idea of “Web life” may be far off, more tangible markers of control are occurring today. For example, Thomas Friedman’s *The World is Flat* purports that ICT like the Web has been a direct enabler for the globalization of various industries, especially considering the proliferation of related “flatteners” like the Web browser.<sup>40</sup> Unfortunately, what Friedman fails to acknowledge are the negative social and political implications of this, such as the degeneration of local cultures through “cultural imperialism” and outsourcing. Through use of the Web, what has resulted is a “flattened” world in terms of the ability for the Global North to dominate the Global South, rather than equal access to the marketplace for all. The Web may indeed serve as a democratizing force, especially when development-related initiatives like the Web Foundation and MW4D Working Group are taken into account, but only when the means of production are also available in addition to the access itself – in other words, the Web must enable a “cultural democracy”. This is a requirement we can begin to satisfy through looking at alternatives to determinism and this dominant paradigm.

### **The Social Constructivist Challenge: Returning to the Forward Slashes**

Again, the major challenge to constructivist approaches to modernizing the Web is rooted in Berners-Lee’s deterministic approach. However, the case for a socially-constructed Web can still be made. Here, it is vital to consider the role of participatory culture and, concomitantly, the

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the proliferation of particular ideologies on the Web’s design and function from people and organizations that serve some kind of regulatory function, as well as the theory that the Web takes on characteristics of living organisms; “social constructivism” and the “social construction of technology”, as a result, refer to any contradictory perspectives, particularly those that assert the importance of end-user communities in shaping the evolution of the technology. This point is taken up further in the following section.

40. Thomas L. Friedman, *The world is flat: A brief history of the twenty-first century* (Vancouver, BC: Douglas & McIntyre, 2007), 60-77.

role of the individual user in scholarship concerning the Web's evolution and future potential. In reference to the example of user-demand negating the requirement to enter the forward slashes into the browser, we are dealing more broadly with the user-generated characteristics of what has been termed "Web 2.0"; a development whose various applications (e.g. social networking sites) allow users to "tag" photos and revise encyclopedia entries, among many other things, based on the fluid knowledge representation model encompassed by the "folksonomy".<sup>41</sup> Within cultural studies and Marxist political economy, the latter has frequently been viewed as "emancipatory" because of the potential access to the means of cultural production that can now be provided through the Web pursuant to this alternative paradigm. This point is indeed taken up further within the social constructivist framework, and is a central concept, in my view.

As mentioned, we are in the midst of a shift from a "Web of Documents" towards a "Web of Data". This is not an entirely new idea, rather one whose implementation has only recently become technologically-feasible. Accordingly, this very purpose-specific modification of the World Wide Web echoes, to some degree, the fact that the Internet (or more generally the network protocols that underlie it), and its predecessor networks like ARPANET, were also created for specific means (in this case, national defence and research). For example, Lisa Gitelman and Janet Abbate both discuss at length the centrality of "invention" in literature relating to the Internet and the Web, suggesting that "unintended consequences" hold less value here than the manifestations of human ingenuity.<sup>42</sup> It is important, however, to note that the pathway to the creation of the Web is more multi-faceted than either authors, or even parts of this

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41. For a fuller discussion on online applications that exemplify the user-driven approach, see David Runciman, "Like boiling a frog: Review of the book *The Wikipedia Revolution*," *London Review of Books* 31, no. 10 (2009): 14-16. <http://www.lrb.co.uk/v31/n10/david-runciman/like-boiling-a-frog> (accessed March 30, 2010).

42. Janet Abbate, *Inventing the Internet* (Cambridge, MA: MIT Press, 1999); Lisa Gitelman, *Always already new: Media, history, and the data of culture* (Cambridge, MA: MIT Press, 2006).

paper, suggest: for example, the role of predecessor networks and applications like France's Minitel and other related methods of viewing textual data on telephones cannot be ignored.

Additionally, an obvious limit of constructivism is that “unintended consequences” (or at least broader and more multi-faceted uses than the Web’s inventor and the W3C could have predicted or facilitated) *did* determinately move us from the initial Web built solely on hyperlinks, on to the interactive elements and services-based architecture characteristic of the Web of today (i.e. “Web 2.0”). However, it can also be argued that computerized machines are unable to replicate the nuanced functions of human intelligence required to effect change. This is, in effect, a position that both helps explain why this view on the evolution of the Web is actually a form of constructivism, and subsequently challenges further work by centralized authorities, such as the underlying notion of the Semantic Web. This said, I argue overall that it is equally difficult to suggest either a completely determinist or a completely constructivist framework, at least within the context of my usage of the terms as previously discussed.

Accordingly, some sort of “middle range” approach is needed to enhance our understanding of where Web Studies fits in the scholarly traditions related to ICTs.<sup>43</sup> Accordingly, it is my supposition that the Social Construction of Technology (SCOT) theory, as professed in related terms by Latour and in specific terms by his contemporaries, can serve this purpose, because it aptly combines elements of both perspectives.<sup>44</sup> In applying this viewpoint, I would argue that the dominant modernization paradigm relating to the ontology reflects, in some

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43. I have adapted this term from Thomas J. Misa, “Retrieving sociotechnical change from technological determinism,” in *Does technology drive history? The dilemma of technological determinism*, eds. Merritt R. Smith and Leo Marx (Cambridge, MA: MIT Press, 1994): 115-141. It is used here within a similar context as its source.

44. A major figure related to this theory is Wiebe Bijker, who indeed co-edited the other papers in the seminal volume containing the Latour text from which this paper’s epigraph was drawn. See also Trevor J. Pinch and Wiebe E. Bijker, “The social construction of facts and artifacts: Or how the sociology of science and the sociology of technology might benefit each other,” in *The social construction of technological systems: New directions in the sociology and history of technology*, eds. Wiebe E. Bijker, Thomas P. Hughes, and Trevor Pinch (Cambridge, MA: MIT Press, 1987): 17-50.



respects, a desire on the part of key personnel involved historically in the development of the Web (namely Berners-Lee) to effectively regain the primary position as the driving force behind a comprehensive research agenda focused on the Web. It thus reflects the need to “manage” the development of the Web, so as to mitigate the negative and unwanted effects on issues related to security, privacy, and trust in transactions, while attempting to stimulate more desirable uses of the technology.

To reiterate, the most immediate theoretical connection that can be made between this perspective and determinist-constructivist approaches involves something on this “middle range” and can be derived from models related to other ICTs: here, studies of the effects of technology on society are still in order, yet they are to be framed with the expectation that at least some of those effects are within the purview of human responsibility and, more specifically, human construction. In other words, and especially given the challenges to the paradigm put forth by the “folksonomy” and user-generated content, a multidirectional model is needed to serve as an analogy for the evolution of the Web. The SCOT model effectively fulfills this purpose, as it holds in general that constant feedback from user groups (i.e. identifiable publics within society as a whole in the case of the Web) aids developers in refining the medium going forward.<sup>45</sup>

Here, we are dealing with what Anderson and Stoneman have termed an “evolutionary model” of ICT development, in that progress is achieved through feedback mechanisms to ensure a sense of malleability of the technology under investigation.<sup>46</sup> However, the difficulty in using SCOT with the assumption that the model of study is “evolutionary” rests with the bidirectional nature of “evolution” itself – that is to say, one is either evolving or devolving, but not necessarily creating peripheral areas for investigation, development, and so forth. The Web, with

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45. Pinch and Bijker, 17-50.

46. Anderson and Stoneman, 11-13.

its broad array of constituent research topics, is hardly bidirectional. Indeed, returning to the whereabouts of the forward slashes, anecdotal evidence may suggest a binary existence (i.e. they were either required by browsers or not), but further empirical research is needed to both solidify this point and to explore what other externalities may be relevant here. As a starting point, the hypothesis I raised earlier about influence from elsewhere in the computing domain of the time would be an excellent starting point for other researchers on this topic to take-up in future. For all of its flaws, Web Science may also provide some answers as it develops, though Berners-Lee's influence remains troubling. This is indeed an area that scholars working in this field would be wise to monitor closely going forward; the possibility of actually participating in projects or conferences organized by the Web Science Trust should be considered.

For now, a major assertion which can be made is that a SCOT-oriented model for the Web must return to the very core of this paradigm as it relates to the evolution of large technological systems. Here, extrapolating the SCOT theories of Thomas Hughes are useful, in that the author argues social, regulatory, and political economic factors shape technology during the stages of development, innovation, technology transfer, and actual utilization.<sup>47</sup> This thought is further supported by the aforementioned “evolutionary” model of technology; however it also draws upon a “conditional and co-adaptation” model wherein how human users interface with the Web determines what the ICT will engender in future.<sup>48</sup> This is to say, how end-user communities socially construct the various elements of the Web is what provides the “progress” and consequences (both intended and unintended) that one then ultimately works to encourage or

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47. Thomas P. Hughes, “The evolution of large technological systems,” in *The social construction of technological systems: New directions in the sociology and history of technology*, eds. Wiebe E. Bijker, Thomas P. Hughes, and Trevor Pinch (Cambridge, MA: MIT Press, 1987): 51-82; Thomas P. Hughes, *Human-built world: How to think about technology and culture* (Chicago: University of Chicago Press, 2004).

48. Anderson and Stoneman, 7-11.

to mitigate as the circumstances warrant. The actual model utilized is arguably less important, so long as this is achieved.

We can thus ground this user-centred paradigm – which we already observe on a daily basis in our interactions with the folksonomy-driven “Web 2.0” environment – within a solid theoretical framework that can then be introduced as a counterpoint to the dominant model of the Web based on technical ontologies, which is espoused through the many projects championed by Berners-Lee and the W3C described in this paper. Therefore, in spite of such a measurable degree of progress that has been asserted over the medium by centralized means, the idea of a viewpoint that negates the technical ontology – that is, in effect, “post-ontological” – has indeed both informed my critique of the state of this track of Web Studies research, as well as suggested my desire to continue conducting research on the ways in which the Web can achieve and maintain minimal non-governmental regulation, thus allowing it to be more freely shaped by end-users to the greater benefit of society.<sup>49</sup>

### **An Additional Perspective on the Medium: The Political and Cultural Economy of “Social Production”**

This last point about the importance of the end-user in “shaping” the online environment deserves amplification, as I argue it is at the core of a democratic Web. At the outset, I assert there are two key ideas that are often lost in the annals of “progress” when it comes to the Web: first, that the Web is a very-public realm that rests on the underlying, and often-privatized or privately-exploited, technological protocols of the Internet (e.g. “walled gardens” like “IPTV”,

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49. In my research, discussions on regulation are focused primarily on non-governmental forms, namely through what I consider the “determinist” perspectives of organizations like the W3C. I argue that a carefully-balanced viewpoint on the Web (where the medium is regulated by non-government and government actors only to the extent that it is demonstrably necessary) increases the capacity for economic, social, and technological innovation by end-users. Although a worthy topic for discussion, the broader issue of Internet and Web regulation (i.e. actually considering how to achieve this “balance”) is outside the remit of this paper.

and even one's home connection as furnished by a corporate ISP); and second, that outright regulation of the Web itself, either through corporations, government or both, is inherently difficult as a result of this socially-constructed decentralism. In fact, it is also counterintuitive to my treatment of the medium as a social construction in its own right.

I have shown so far that the Web, in spite of this, is not an altogether "uncontrollable" space (as demonstrated in this paper by the influence of groups like the W3C through the evolving research agenda of major figures like Berners-Lee, but also more broadly by the current practices of governments like China). At the same time, however, various aspects of technological convergence have enabled multiple forms of user-generated content to grow in popularity in the online environment, and this overall concept of the democratization of the Web – known by several names but most importantly for the purposes of this paper as "social production"<sup>50</sup> – holds the potential to fundamentally shift how we create cultural product and how we understand intellectual property, particularly in non-Communist market configurations.

To this end, the post-ontological critique can be informed by contrasting more widely-accepted theories of the medium with alternative political and cultural economies of the Web: for example, Yochai Benkler's concepts of "social production", the "networked information economy", and the "networked public sphere" (all derived from his seminal text *The Wealth of Networks*).<sup>51</sup> This final section of the paper briefly introduces Benkler's work, with the intent of distilling certain key points that may aid further study on the political economy of the Web, particularly as it relates to end-users and the folksonomy.

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50. Yochai Benkler, *The wealth of networks: How social production transforms markets and freedom* (New Haven, CT and London: Yale University Press, 2006).

51. Ibid.

*Origins of the Folksonomy in Media Theory and Cultural Studies*

Much scholarship in recent years has been dedicated to understanding “cyber culture”, and has, to some degree, been focused on extending the theories of Marshall McLuhan and Harold Innis to the case of the Web and the online realm. With McLuhan, this relates especially to notions of media theory, and with Innis, to the idea of the “bias of communication”.<sup>52</sup> In some circumstances, such discussions regarding the Web as a medium rely on an underlying assumption that the technology has a direct causal effect on society. Examples of such determinist perspectives centre on the idea that society has been altered by the Web in terms of knowledge sharing, the creation of a larger sense of community, and new collective aspirations as a result.<sup>53</sup> My intent with these theorists is not necessarily to prove or disprove how they conform to determinist or constructivist ends, rather to understand how areas for studying new Web technologies, like the Web Science discipline may extract utility from them.

To this end, beginning with perspectives that relate to Innis’s work will prove useful. For instance, Xiaoquan Zhao argues that the Internet (and presumably the Web) is both space *and* time-biased: although the Web is a key driver towards globalization and reducing geographic divides in a virtual sense, so too does it enable citizens, and publics of all sorts, to construct new notions of democratic governance and data sharing in the long-term, which are arguably important to deconstructing traditional spatial, temporal, and power-related constraints.<sup>54</sup> By applying a theoretical construct termed a “six dimensions framework”, Limor Shifman and Menahem Blondheim conclude that the Innisian perspective (with respect to both political

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52. Robert Burnett and P. David Marshall, *Web theory: An introduction* (London: Routledge, 2003).

53. David Weinberger, *Small pieces loosely joined: A unified theory of the Web* (New York: Basic Books, 2002).

54. Xiaoquan Zhao, “Revitalizing time: An Innisian perspective on the Internet,” in *The Toronto School of communication theory: Interpretations, extensions, applications*, eds. Rita Watson and Menahem Blondheim (Toronto, ON: U of T Press, 2007): 199-214.

economy and thoughts on space-time bias) cannot be effectively applied to the online environment because the Web is not one distinct medium, but a meta-medium that encompasses traditionally separate media like print, radio, television, cinema, and so forth.<sup>55</sup> Instead, since the Web serves as a delivery vehicle for such media, and since it may indeed deconstruct both space and time, the corollary of the arguments above is that attempts to extend deterministic media theory to the Web are largely unsuccessful. We remain in control because the meta-medium can reflect the democratic intentions of its users; moreover, if the meta-medium is managed sufficiently, the deconstruction of bias that results serves society well in mitigating the historically imperialist tendencies of other forms of communication.

### *The Web as Enabling a Cultural Democracy*

Discussions about the Web and the W3C's work on projects such as Web Science are informed by media theory and related discourse because of the interest in studying the varied qualities of this ICT. But as has just been shown, the key value in connecting the Web to such dialogue is also rooted in understanding what the Web is not. This is perhaps most true when we consider one of the key tenets of media theory, namely McLuhan's idea that "the medium is the message" coupled with the notion that media can enable a "global village" and how this is applied to the online environment.<sup>56</sup> Indeed, if we look upon the Web as a meta-medium, then the question becomes, is it capable of embodying the distinct message put forth by the respective constituent medium, or does it embody some sort of consolidated message that reflects the sum

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55. According to the authors, this "six dimensions framework" represents a taxonomy for conceptualizing all media technology, and considers the morphology, scalability, synchronicity, directionality, mode, connectivity, and throughput of the medium. See Limor Shifman and Menahem Blondheim, "From the spider to the Web: Innis' ecological approach to the evolution of communication technologies," in *The Toronto School of communication theory: Interpretations, extensions, applications*, eds. Rita Watson and Menahem Blondheim (Toronto, ON: U of T Press, 2007): 337-353.

56. Paul Levinson, *Digital McLuhan: A guide to the information millennium* (New York and London: Routledge, 1999).

of its parts? I would argue that the Web transmits, above all else, a unique message – one of cultural democracy versus the democratization of culture.

Analogies between the latter and a “global village”, and between the former and a “world bazaar”, can be drawn.<sup>57</sup> Essentially, what this means is that the Web as a decentralized and democratic medium can, when left unregulated and uncensored, provide a cultural delivery vehicle that is more equitably accessed. Granted, steps must be taken to ensure people have access to ICTs in general (i.e. that they have access to the means of production, encoding, and reception of the message), but the Web is nonetheless a conduit that can allow for a greater degree of free expression than traditional, offline media, by design. If near-universal access to content from predominantly developed nations can be achieved through offline ICTs in creating our “global village” of today, then it is the online ICTs like the Web that will allow all “villagers” to more easily contribute to a global marketplace of ideas tomorrow.

### *Problematic Theories of the Cultural Economy*

This discussion can also be re-framed within the cultural economy perspective, thus allowing us to create broader linkages with both cultural studies and political economy. Here, I will draw heavily upon Yochai Benkler’s *The Wealth of Networks* to illustrate my points, which should be viewed as an extension of the social constructivist model that was previously discussed, though focused more significantly in political economy.<sup>58</sup> Overall, what is most interesting about Benkler’s work is his decidedly different perspective on the characteristics of

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57. Barry Vacker, “Global village or world bazaar?” in *Understanding the Web: Social, political, and economic dimensions of the Internet*, eds. Alan B. Albarran and David H. Goff (Ames: Iowa State University Press, 2000): 211-237.

58. See also Patrice Filchy, *Understanding technological innovation: A socio-technical approach*, trans. Liz Carey-Libbrecht (Northampton, MA: Edward Elgar, 2007). Here, the author puts forth a related ideology known as the “socio-technical frame of reference”, which is also useful in understanding the communications and cultural studies perspectives beyond SCOT theory that foreground Benklerian political economy.

our present economic era, and this requires further amplification. To be sure, several other well-known political and cultural economists have written at length about the role of ICTs (and especially the Internet and the Web) in shaping today's "knowledge economy", but this is seldom differentiated from how we understand the implications of offline mass media; as a result, I would suggest that fallacious, and potentially hegemonic, arguments are extrapolated into the realm of the cultural economy.

For example, the literature about the Web that is written in the tradition of McLuhan, and that evokes media theory, may beget an economic argument like Thomas Friedman's in which, as discussed, the technology serves as a global "flattener", supposedly creating social and economic opportunity for all who have access to it.<sup>59</sup> In this vein, however, the Web is just a more efficient enabler of the "global village", wherein culture is democratized simply in the sense of being made more widely available. Of course, this view is problematic because it does nothing to address the political economy of cultural production itself. "The message" can thus be transported in new ways, but this "one to many" model, which resembles the broadcasting system, ignores the fact that major socioeconomic divides persist between the Global North and the Global South. "The world is flat" in the sense that those who already control the means of production can maximize resources by exploiting new markets via the use of the Web, while others can only "benefit" by supplying less expensive, outsourced labour.

In contrast, Barry Vacker's "world bazaar" concept asserts that all "global villagers" have the potential to reach their publics and thus contribute to the ongoing dynamic between the Web's effect on society and vice versa.<sup>60</sup> Overall, this offers a focal point upon which the cultural and technological aspects of this emerging Web environment can be balanced with

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59. Friedman, 92-93.

60. Vacker, 211-237.



alternative viewpoints grounded in the cultural economy. Indeed, the argument I would fashion from all of this is that this new online paradigm is one of a cultural democracy (meaning greater opportunities for marginalized publics), rather than the democratization of culture (which, as discussed, refers solely to the greater dissemination of material produced by dominant cultures). But this is not simply achieved by understanding how the determinist model of the cultural economy is problematic; it merely puts us in a better position to appreciate the focus of Benkler's text, which is the importance of the macro-effects of raw data and collaboration.

### *Locating Cultural Value in the Networked Information Economy*

The subtitle of Benkler's work is "how social production transforms markets and freedoms", and logically it is this notion of social production that enables what Benkler terms the networked information economy and the networked public sphere (or in this case, what I have until now termed more generally the notion of the cultural democracy). Benkler's approach to foregrounding this new cultural economic sphere is, in some respects, quite different from the theoretical counterpoint I have provided above. But seeing that an entire chapter of his text is dedicated to lamenting "the trouble with mass media", I suggest I have at least captured the essence of his arguments pertaining to the problems with the status quo, namely the increasing corporatization of, and integration within, the media industries.<sup>61</sup> But I have yet to explain what is at the core of the culturally-democratic ideals of the networked information economy, at least as compared to the "industrial information economy" that is slowly being displaced. Here, Benkler offers an explanation for what actually enables the cultural democracy to flourish and thus what constitutes the networked information economy and the phenomenon of social production: first, easier access to the means of cultural production (i.e. "the declining price of

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61. Benkler, 176.

computation, communication, and storage”); and second, the actions of individuals across decentralized networks like the Web in the pursuit of “cooperative and coordinate action” carried out through “nonmarket mechanisms that do not depend on proprietary strategies”.<sup>62</sup>

Effectively, this is to say that increasingly-distributed access to production tools, coupled with the adoption of the public Web as a means to diffuse content and collaborate on its production, constitutes the new information production system *par excellence*. And here, value is to be found more so in the raw data itself, and in how users work with that data (i.e. how they “socially produce” content), than in the finished product itself.<sup>63</sup> To this end, Benkler presents several mainstream examples of what he considers exemplars of the networked information economy: chief among them are Wikipedia, open source software (various Linux distributions especially), and SETI@Home, a super-computer created from the leftover cycles of personal computers linked via the Web.<sup>64</sup> With each of these, and especially with the first two examples, the manipulation of the underlying data by various groups of people is paramount to their success as cultural objects. In addition, much of their utility is derived from the relationships that are formed around the data, namely the collaborative nature of knowledge development, mobilization, and dissemination that, at times, resembles something akin to the academic peer review process. Wikipedia, for instance, derives much of its use value from its “read/write” nature, and is a major interest for Benkler because of this fact.

Although they are not a primary focus of his work, I would add examples of social production from the audiovisual realm to Benkler’s exploration, especially the user-generated,

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62. Benkler, 3.

63. This is not dissimilar to McLuhan’s aphorism that “the medium is the message”, though I am choosing not to focus explicitly on such a connection in this paper.

64. Benkler, 5.

streaming content (also known as broadband or “IP” video) that has become the cornerstone of various social networking applications and video aggregator sites (as with my earlier discussion on the folksonomy, this would include sites like “YouTube”, “Facebook”, “Flickr”, and the like). Although the material in these forums often fails to fit the more lofty goals for social production that we might like to set vis-à-vis democracy and social change, I argue this is less important than the possibilities that are at least created by such means.<sup>65</sup> Indeed, a recent documentary co-produced by the National Film Board of Canada underscores applications of what I would perceive to be the “Benklerian tradition” to audiovisual cultural product: entitled *RiP: A Remix Manifesto*, the film focuses on the political economy of cultural “mash-ups”, which are effectively new products created from the sampling of existing, and often copyrighted, material. In addition to exploring the implications of such social production (especially the music industry and the debates over piracy that were spawned by it), the film itself is an example of it, since viewers are invited to create their own “remix” of its content to share via the Web for possible inclusion in future documentary media released by the director’s production company.<sup>66</sup>

### *Social Production and its Relation to the “Web of Data”*

Preliminary connections can be made between the concepts of social production and the networked information economy, while offering opportunities for further research both within and outside of the alternative modernization paradigm’s work towards the realization of the networked public sphere using the new Web technologies outlined in this paper. The most

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65. Although this is a highly-subjective measure, an illustration of this argument would be clips of cats riding robotic vacuum cleaners, which arguably do little to further such social goals in and of themselves. However, the same networks, technologies, and storytelling/content production techniques in use here demand our attention because of the potential they hold to effect social change when used otherwise (consider, for example, the role of the micro-blogging site Twitter in Iran’s disputed 2009 presidential elections).

66. Brett Gaylor, *RiP: A Remix Manifesto*, DVD, directed by Brett Gaylor (Montréal, QC: EyeSteelFilm, 2009). See also the companion website, <http://ripremix.com>, where users can submit their own remixes of the film’s contents as discussed.

evident connection between these efforts under development and Benkler's take on the cultural economy can be found in a mutual focus on data and its importance in the production process, specifically with respect to Berners-Lee's ultimate goal of realizing the Semantic Web or "Web of Data". Although this was previously characterized as a part of the dominant paradigm, I assert there is some value in leveraging work done to date on ontologies in the service of ensuring the alternative model, based on folksonomies, ultimately prevails. More specifically, the enhanced autonomy that intelligent agents could provide through semantic annotation could enhance social production by putting more powerful Web language markup tools in the hands of the general public. Additionally, the Web Science discipline (and more specifically the Web Science Trust) may be able to use its research to illuminate some of the fundamental challenges Benkler sees in advancing social production from a subversive, non-market activity to one that ultimately realigns the core economic system to a true cultural democracy – that is, the networked information economy giving way to a broader networked public sphere that positions social production at the forefront of market activity.

This point requires further elaboration. In order to realize the networked public sphere, Benkler outlines five specific design characteristics that are required: universal intake; the ability to filter for potential relevance ("political relevance" in his terms); the potential to filter for accreditation; the means to synthesize public opinion; and lastly, the requirement to remain independent from government control.<sup>67</sup> Several of these are relatively simple to address, at least in building a preliminary research agenda for future work in the area of Web Science. For instance, the means to furnish the "universal intake" of social production are either evident (for example, increasingly inexpensive consumer production equipment and broadband Internet access), or are already part of the remit of W3C-affiliated organizations, like the Web Science

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67. Benkler, 182-185.

Trust, the MWI, the MW4D group, and the Web Foundation (especially fundamental issues of access to Web infrastructure and the digital divide). Similarly, based on the research and development that has thus far been conducted on next-generation Web technologies, the ontology-driven framework of the future online environment is already focused on addressing requirements to filter for relevance and contextual legitimacy, so as to ensure accuracy and trustworthiness (i.e. accreditation), and to synthesize data. Again, this is a major focus of research on the Semantic Web within the research agenda of the Web Science Trust.

### *Towards the Decentralized, Networked Public Sphere*

Benkler's final requirement for the networked public sphere, which is independence from government control, raises yet another challenge to the notion of a Web dominated by technical ontologies, and thus deserves special consideration. To be sure, much of what Benkler presents in his text may prove challenging to implement in the long-term, given the inertia of governments towards changing the existing system of intellectual property protection (which is generally quite restrictive of certain aspects of social production, namely the remix concept); moreover, even when intellectual property is less the issue, such as when a collective of independent producers wishes to produce and subsequently modify their own content, financial considerations related to the production process itself remain.

In effect, Benkler does not adequately explain how social producers are expected to make a living as cultural workers, let alone cover their production expenses (even when they are amateurs). Presumably, he is not suggesting people be altruistic, rather if the folksonomy-driven Web continues to grow in popularity, governments may eventually modify public policy regarding the definition and protection of intellectual property and, as a result, affect how related cultural objects can be funded and financially exploited. Again though, the immediate issue is a

sort of paradox, wherein policymakers may not take the networked information economy as seriously without high-quality, meaningful examples of social production, yet access to resources in the decentralized environment is necessary to finance such production in the first place. This is a mere observation to point out as an aside, given the focus of this paper on the underlying realities of online progress itself, versus more of the offline policy considerations such as intellectual property and economic imperatives.

More importantly for my purposes, however, a further paradox requiring discussion stems from the very configuration of the Web itself as a decentralized and generally unregulated technology and meta-medium. As noted earlier, Tim Berners-Lee and the Web Science Trust regard decentralization as a requisite feature that must be maintained in further developing Web architecture. Somewhat ironic, though, is the fact that the W3C's endeavours are viewed as a means to construct and maintain this decentralization, sort of a *de facto* form of regulation within the framework of a *de jure* unregulated Web. Even going back to *Weaving the Web*, Berners-Lee and Fischetti reflect on the importance of standards groups like the W3C in setting quality assurance guidelines for Web development.<sup>68</sup> I would argue that, as a consequence, emerging disciplines like Web Science are designed to carry on this legacy by suggesting best practices through which Web users, businesses, and governments can ensure beneficence in their interactions with the online realm, specifically the Semantic Web.

Nevertheless, the risk remains that valorizing the W3C's dominant modernization paradigm will only further propagate a determinist perspective on the Web, as it relies heavily on the use of technical ontologies with prescribed vocabularies. However, this can be mitigated by attempting to achieve a balance in terms of applying just enough regulation to maintain a

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68. Tim Berners-Lee and Mark Fischetti, *Weaving the Web: The original design and ultimate destiny of the World Wide Web* (San Francisco: Harper Business, 1999).

decentralized topology. According to Benkler, this is the type of environment that may be most conducive to social production: he avoids a determinist approach, as this would be no better than the government control which he finds problematic; however, he does not argue for all-out libertarian or anarchistic paradigms instead.<sup>69</sup> For him, the State is not completely discounted; rather it can take a role in facilitating this new political and cultural economy – one that is not entirely dissimilar to the role played in development of the Habermasian public sphere with other media. Nonetheless, the degree to which knowledge representation models exist as top-down, controlled vocabularies – regularized semantic systems – versus user-driven, “crowdsourced” annotations – folksonomies – will need to be addressed by researchers as a first step towards achieving this balance. In summary, Benkler’s perspectives on the Web tend towards an alternative modernization paradigm based on a user-centred, social constructivist approach; this said, control itself by groups like the W3C is not entirely negated.

### *Further Research on the Cultural Industries*

As a final point, one that is in some respects tangential though relevant on the macro-level, it is worthwhile considering the broader relation of this debate over the two paradigms within an enduring divide that is often-considered within cultural studies. More specifically, there is merit in exploring (albeit in further research) connections that can be made with the Frankfurt School, namely the “cultural industry thesis”.<sup>70</sup> The key research question here, then, would involve the extent to which Web research on the ontology versus folksonomy divide mirrors the dialectic set out by Horkheimer and Adorno, particularly with respect to enduring debates over “high” versus “low” culture (in this case, the Web as envisioned by centralized

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69. Benkler, 16.

70. See Max Horkheimer and Theodor W. Adorno, *Dialectic of Enlightenment*, trans. John Cumming (New York: Continuum, 1995).

authorities versus a Web that is wholly-participatory and organized by the end-user communities themselves). Such a research agenda would also assist in taking the above further into what could truly evolve to become “post-ontological” territory, though additional enduring debates over modernism and post-modernism – alongside the evident pitfalls of prematurely or haphazardly attaching the “post” prefix to concepts – would also need to be introduced in order to properly contextualize this discussion, as well as the ensuing debates over the fundamental issue of periodization that is rife within cultural studies.

### **Conclusion**

The purpose of this paper was to introduce two major competing paradigms related to the modernization of the Web (in terms of both planned and realized goals), and to situate this work within theoretical discussions of determinism and the social construction of technology (as accomplished both through the framing device of the forward slashes and, more broadly, through some discussion on relevant theoretical perspectives). My intention was simply to review and discuss a small subset of the relevant literature in this area, so as to help provide a firmer foundation upon which new ideas can be generated and subsequently ferment. Additionally, by introducing the work of Yochai Benkler on the importance of a user-driven Web to the future of the cultural democracy, I have both further informed and complicated the debate over top-down and bottom-up approaches to the evolution of technology, given my position that utility must be extracted from both perspectives in order to allow the least-restrictive configuration to ultimately dominate. If this work seems tentative or incomplete, it is because research subjecting the work of Tim Berners-Lee and the World Wide Web Consortium to this degree of critical analysis from the perspectives of communication and cultural studies is an emerging area of inquiry in my



view. It is primarily for this reason that I argue we have only been equipped to move “towards” post-ontological viewpoints as of yet.

Moreover, despite the lofty goals of Web-related research consortia (such as the Web Science Trust) towards unifying Web Studies to further social benefits, this particular area remains especially lacking in scholarship regarding pertinent theoretical foundations, along with methods to conceptualize technological progression within this context. As it is now too focused on coding, studies of the Web need this to inform the discipline. One major conclusion I would draw from this research, and from considering the vignette concerning the negation of the requirement to include the forward slashes in the URI that began this paper, is that future studies – and particularly histories and historiographies – of the Web should approach it as being an element of ICT that is heavily constructed by, at times, competing ideologies. Therefore, leveraging a framework that recognizes this, such as theories on the social construction of technology as introduced within, will prove beneficial in further attempting to understand how best to study and engage with the Web, both now and in future.

## Bibliography

- Abbate, Janet. *Inventing the Internet*. Cambridge, MA: MIT Press, 1999.
- Ahmed, Murad. "Backslash: Web creator Sir Tim Berners-Lee apologises for his strokes." *The Times*, October 14, 2009. <http://technology.timesonline.co.uk> (accessed March 30, 2010).
- Anderson, Ben, and Paul Stoneman. "Predicting the socio-technical future (and other myths)." In *ICT futures: Delivering pervasive, real-time and secure services*, edited by Paul Warren, John Davies, and David Brown, 3-16. West Sussex, England: John Wiley & Sons, 2008.
- Anderson, Janna Q. "Tim Berners-Lee launches 'WWW Foundation' at IGF 2009." *Ars Technica*, November 16, 2009. <http://arstechnica.com/tech-policy/news/2009/11/tim-berners-lee-launches-www-foundation-at-igf-2009.ars> (accessed December 14, 2009).
- Barabási, Albert-László. *Linked: How everything is connected to everything else and what it means for business, science, and everyday life*. New York: Plume, 2003.
- Benkler, Yochai. *The wealth of networks: How social production transforms markets and freedom*. New Haven, CT and London: Yale University Press, 2006.
- Berners-Lee, Tim, and Mark Fischetti. *Weaving the Web: The original design and ultimate destiny of the World Wide Web*. San Francisco: Harper Business, 1999.
- , Wendy Hall, James A. Hendler, Kieron O'Hara, Nigel Shadbolt, and Daniel J. Weitzner. "A framework for Web Science." *Foundations and Trends in Web Science* 1, no. 1 (2006): 1-130.
- , Wendy Hall, James Hendler, Nigel Shadbolt, and Daniel J. Weitzner. "Creating a science of the Web." *Science*, no. 5788 (August 2006): 769-771.
- , James Hendler, and Ora Lassila. "The Semantic Web." *Scientific American* 284, no. 5 (May 2001): 34-43.
- Boyera, Stéphane. "Can the Mobile Web bridge the digital divide?" *Interactions* 14, no. 3 (2007): 12-14.
- . "White paper on Mobile Web for social development." *World Wide Web Consortium*, 2008. [http://www.w3.org/2006/12/digital\\_divide\\_ajc](http://www.w3.org/2006/12/digital_divide_ajc) (accessed October 28, 2009).
- Burnett, Robert, and P. David Marshall. *Web theory: An introduction*. London: Routledge, 2003.
- Business Wire. "W3C seeks partners to explore role of mobile in bridging digital divide; multidisciplinary forum to address access, literacy, sustainability challenges." May 27, 2008. LexisNexis (accessed October 23, 2009).

- Chon, Kilnam. "The future of the Internet digital divide." *Communications of the ACM* 44, no. 3 (2001): 116-117.
- Dejong, Jennifer. "Mobile Web." *PC Magazine* 20, no. 13 (July 2001): 140-143.
- Feigenbaum, Lee, Ivan Herman, Tonya Hongsermeier, Eric Neumann, and Susie Stephens. "The Semantic Web in action." *Scientific American* 297, no. 6 (December 2007): 90-97.
- Filchy, Patrice. *Understanding technological innovation: A socio-technical approach*. Translated by Liz Carey-Libbrecht. Northampton, MA: Edward Elgar, 2007.
- Fischetti, Mark. "A science of the Web begins." *Scientific American*, November 2, 2006.  
<http://www.sciam.com/article.cfm?id=a-science-of-the-web-begi> (accessed April 25, 2010).
- Fitzgerald, Michael. "Mobile Web: So close yet so far." *New York Times*, November 27, 2007.
- Friedman, Thomas L. *The world is flat: A brief history of the twenty-first century*. Vancouver, BC: Douglas & McIntyre, 2007.
- Gaylor, Brett. *RiP: A Remix Manifesto*, DVD. Directed by Brett Gaylor. Montréal, QC: EyeSteelFilm, 2009.
- Geller, James, Soon Ae Chun, and Yoo Jung. "Toward the Semantic Deep Web." *Computer* 41, no. 9 (September 2008): 95-97.
- Gitelman, Lisa. *Always already new: Media, history, and the data of culture*. Cambridge, MA: MIT Press, 2006.
- Greaves, Mark. "Semantic Web 2.0." *IEEE Intelligent Systems* 22, no. 2 (2007): 94-96.
- Harper, Simon. "Mobile Web: Reinventing the wheel?" *SIGACCESS Newsletter*, no. 90 (January 2008): 16-18.
- , Yeliz Yesilada, and Carole Goble. "Building the Mobile Web: Rediscovering accessibility?" *Universal Access in the Information Society* 6, no. 3 (2007): 219-220.
- Heath, Tom. "How will we interact with the web of data?" *IEEE Internet Computing* 12, no. 5 (2008): 88-91.
- Hendler, James. "Web 3.0: Chicken farms on the Semantic Web." *Computer* 41, no. 1 (January 2008): 106-108.
- . "Web 3.0 emerging." *Computer* 42, no. 1 (January 2009): 111-113.

- , Nigel Shadbolt, Wendy Hall, Tim Berners-Lee, and Daniel Weitzner. "Web Science: An interdisciplinary approach to understanding the Web." *Communications of the ACM* 51, no. 7 (2008): 60-69.
- Horkheimer, Max, and Theodor W. Adorno. *Dialectic of Enlightenment*. Translated by John Cumming. New York: Continuum, 1995.
- Hughes, Thomas P. *Human-built world: How to think about technology and culture*. Chicago: University of Chicago Press, 2004.
- . "The evolution of large technological systems." In *The social construction of technological systems: New directions in the sociology and history of technology*, edited by Wiebe E. Bijker, Thomas P. Hughes, and Trevor Pinch, 51-82. Cambridge, MA: MIT Press, 1987.
- Knorr, Eric. "Mobile Web vs. reality." *Technology Review* 104, no. 5 (2001): 56-61.
- Kroski, Ellyssa. "What is the Mobile Web?" *Library Technology Reports* 44, no. 5 (2008): 5-9.
- Latour, Bruno. "Where are the missing masses? The sociology of a few mundane artifacts." In *Shaping technology/building society: Studies in sociotechnical change*, edited by Wiebe E. Bijker, and John Law, 225-258. Cambridge, MA: MIT Press, 1992.
- Levinson, Paul. *Digital McLuhan: A guide to the information millennium*. New York and London: Routledge, 1999.
- MacKenzie, Donald. *Knowing machines: Essays on technical change*. Cambridge, MA: MIT Press, 1996.
- Miller, Eric. "The W3C's Semantic Web activity: An update." *IEEE Intelligent Systems* 19, no. 3 (2004): 95-97.
- Misa, Thomas J. "Retrieving sociotechnical change from technological determinism." In *Does technology drive history? The dilemma of technological determinism*, edited by Merritt R. Smith, and Leo Marx, 115-141. Cambridge, MA: MIT Press, 1994.
- Mobile Web Initiative (MWI). "About the Mobile Web initiative." World Wide Web Consortium. <http://www.w3.org/Mobile/About> (accessed October 23, 2009).
- Mobile Web for Social Development Working Group (MW4D). "Documents & resources." World Wide Web Consortium. <http://www.w3.org/2008/MW4D> (accessed October 23, 2009).
- Murphy, Michael J., Michael Dick, and Thomas Fischer. "Towards the 'Semantic Grid': A state of the art survey of Semantic Web services and their applicability to collaborative design, engineering, and procurement." *Communications of the IIMA* 8, no. 3 (2008): 11-24.

O'Hara, Kieron, and Wendy Hall. "Web Science." *Association of Learning Technologies Newsletter*, no. 12 (May 2008).

O'Malley, Chris. "Wireless Web or prison cell? (Combining the World Wide Web and mobile phones)." *Popular Science* 256, no. 6 (June 2000): 11.

Pinch, Trevor J., and Wiebe E. Bijker. "The social construction of facts and artifacts: Or how the sociology of science and the sociology of technology might benefit each other." In *The social construction of technological systems: New directions in the sociology and history of technology*, edited by Wiebe E. Bijker, Thomas P. Hughes, and Trevor Pinch, 17-50. Cambridge, MA: MIT Press, 1987.

Richards, Justin. "Mobile Web." *ITNow* 48, no. 5 (September 2006): 10.

Runciman, David. "Like boiling a frog: Review of the book *The Wikipedia Revolution*." *London Review of Books* 31, no. 10 (2009): 14-16. <http://www.lrb.co.uk/v31/n10/david-runciman/like-boiling-a-frog> (accessed March 30, 2010).

Scanlon, Jessie. "Moving to the Mobile Web." *BusinessWeek Online*, no. 14 (2008). EBSCO (accessed October 23, 2009).

Science Business Publishing. "New Web research at network gets off the ground." *Science|Business*, April 29, 2010. Available via <http://bulletin.sciencebusiness.net> (accessed May 1, 2010).

Shadbolt, Nigel, and Tim Berners-Lee. "Web Sciences Emerges", or "Web Science: Studying the Internet to protect our future". *Scientific American* 299, no. 4 (October 2008): 32-37 or 76-81.

—, Wendy Hall, and Tim Berners-Lee. "The Semantic Web revisited." *IEEE Intelligent Systems* 21, no. 3 (2006): 96-101.

Shifman, Limor, and Menahem Blondheim. "From the spider to the Web: Innis' ecological approach to the evolution of communication technologies." In *The Toronto School of communication theory: Interpretations, extensions, applications*, edited by Rita Watson, and Menahem Blondheim, 337-353. Toronto, ON: U of T Press, 2007.

Shneiderman, Ben. "Web Science: A provocative invitation to Computer Science." *Communications of the ACM* 50, no. 6 (2007): 25-27.

Siau, Keng, and Fiona Fui-Hoon Nah. "Mobile technology in education." *IEEE Transactions on Education* 49, no. 2 (2006): 181-182.

Tetlow, Philip. *The Web's awake: An introduction to the field of Web Science and the concept of Web life*. Hoboken, N.J.: John Wiley, 2007.

- Thomson, Rebecca. "Web science: Exploring the network without guesswork." *New Scientist*, May 10, 2010. Available via <http://www.newscientist.com> (accessed May 12, 2010).
- Vacker, Barry. "Global village or world bazaar?" In *Understanding the Web: Social, political, and economic dimensions of the Internet*, edited by Alan B. Albarran, and David H. Goff, 211-237. Ames: Iowa State University Press, 2000.
- Vaughan-Nichols, Steven J. "The Mobile Web comes of age." *Computer* 41, no. 11 (2008): 15-17.
- Warren, Paul, and John Davies. "The Semantic Web - from vision to reality." In *ICT futures: Delivering pervasive, real-time and secure services*, edited by Paul Warren, John Davies, and David Brown, 55-66. West Sussex, England: John Wiley & Sons, 2008.
- Web Science Trust. "Creating a science of the Web (project website); People; Research Roadmap." <http://www.webscience.org>, <http://webscience.org/people.html>, and <http://webscienceoc.org/research/roadmap.html> (accessed April 25, 2010, and July 14, 2010).
- Weinberger, David. *Small pieces loosely joined: A unified theory of the Web*. New York: Basic Books, 2002.
- World Wide Web Consortium. "Project website." <http://www.w3.org> (accessed April 25, 2010).
- World Wide Web Foundation. "Executive Summary; Our History." <http://www.webfoundation.org/wp-content/uploads/2009/11/WebFoundation-ExecSumm.pdf>, and <http://www.webfoundation.org/about/history/> (accessed December 14, 2009).
- Wright, Alex. "Searching the Deep Web." *Communications of the ACM* 51, no. 10 (2008): 14-15.
- Zhao, Xiaoquan. "Revitalizing time: An Innisian perspective on the Internet." In *The Toronto School of communication theory: Interpretations, extensions, applications*, edited by Rita Watson, and Menahem Blondheim, 199-214. Toronto, ON: U of T Press, 2007.